

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



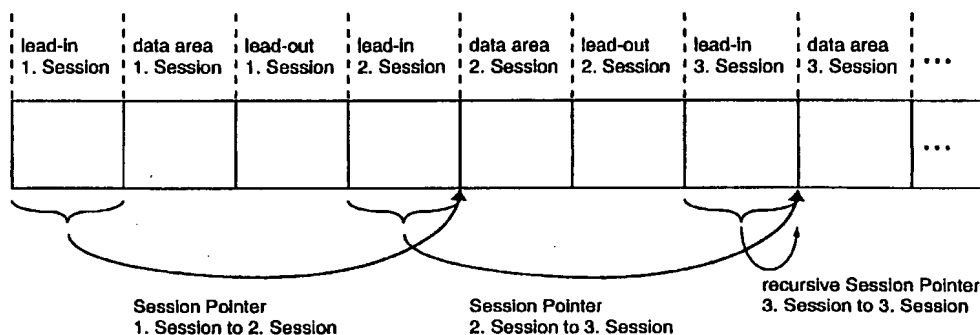
(43) International Publication Date
18 October 2001 (18.10.2001)

PCT

(10) International Publication Number
WO 01/78074 A1

- (51) International Patent Classification⁷: **G11B 20/00**, (74) Agent: **GÖRZ, Ingo**; Müller & Hoffmann, Innere Wiener Strasse 17, 81667 München (DE).
20/14, G06F 1/00, G11B 20/12
- (21) International Application Number: **PCT/EP01/02633** (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (22) International Filing Date: **8 March 2001 (08.03.2001)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:
00107599.3 7 April 2000 (07.04.2000) EP (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant (*for all designated States except US*): **SONY DADC AUSTRIA AG** [AT/AT]; Niederalm 282, A-5081 Anif (AT).
- (72) Inventors; and
(75) Inventors/Applicants (*for US only*): **WINTER, Andreas** [AT/AT]; Digital Audio Disc Company, Sony DADC Austria AG, Niederalm 282, A-5081 Anif (AT). **PODHAJSKI, Stefan** [AT/AT]; Digital Audio Disc Company, Sony DADC Austria AG, Niederalm 282, A-5081 Anif (AT).
- Published:
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **OPTICAL DISC COPY PREVENTION SYSTEM**



(57) Abstract: The present invention describes a method how to modify the physical data stream on an optical storage disc of a predetermined type to influence the decoding process in a way that a general purpose reading device which can access multi-session record carriers gets confused so that the record carrier is judged unaccessible, e.g. by making it impossible to find the exact synchronization and timing or by defining a recursive session pointer. This may lead either to stopping of the decoding process or at least to a wrong decoding of data symbols.

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Description**Optical Disc Copy Prevention System**

5 The present invention relates to a copy protection method for record carriers, i.e. storage media, which store digital data as an asynchronous signal, e.g. Compact Discs (CDs) and Digital Versatile Discs (DVDs) including all existing or future formats of CD and DVD or other Optical Storage Media which work according to a similar concept.

10

In particular, the copy protection method according to the present invention prevents of the ability to make a physical copy or creating a complete data image of the media content.

15

Optical storage discs with information stored on one or both sides have come to be used for a variety of purposes, most notably in the music, games, video and computer industry. Digital information is stored on the optical storage media in the form of pits arranged along circular, concentric tracks on one or on both sides of the disc. The track is typically read from the inside out, but may also be read from outside in, as it is already used for some optical storage media.

20

The data itself on the track is subdivided into frames, each equal in length, containing equal amounts of information. Each frame has a dedicated layout depending on the type of optical storage media (CD, DVD). Such a frame always contains the user data symbols itself but also data for synchronization, merging data between data symbols and error correction.

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The signal on a optical storage medium itself is asynchronous, which means that in the decoding process synchronization and timing information has to be spied out from the signal.

30

Due to the nature of such storage media copies can be made easily. To cope with this situation, there exist various copy protection schemes which try to prevent unauthorized access with the help of keys or passwords stored on the respective storage medium itself. Further, there exist methods which secure an optical disc with the help of stored invalid information which gets repaired during the copy process so that an application program can determine whether it is stored on an original or

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1 on a copy based on the presence or absence of this invalid information.

However, these copy protection schemes only prevent the copying in an indirect way, i.e. copying is possible and only the access of a copied record carrier might be
5 restricted.

Further, US 6,005,839 describes a copy protection scheme for optical record carriers, in particular DVDs, according to which direct or dump copying is prohibited by inserting a synchronization pattern at an irregular position different from the regular position or by inserting a synchronization pattern different to the standard synchronization pattern at the regular position of certain areas or sectors of the optical
10 record carrier. To assure an undisturbed reproduction of such a record carrier the reproducing obstructing area created with the misleading synchronization patterns is skipped by jumping based on position designating information (designating the reproducing obstructing area) which is recorded on the record carrier, preferably
15 in the Table Of Contents (TOC) area.

Therefore, it is an object underlying the present invention to provide an improved copy protection method, i.e. a method to produce a record carrier which comprises
20 an improved copy protection, a record carrier with an improved copy protection, and a record carrier writing device which can produce such record carriers.

The method according to the present invention is defined in independent claim 1, a record carrier with a copy protection according to the present invention is defined
25 in independent claim 11, and a record carrier writing device which can produce such record carriers is defined in independent claim 20. Preferred embodiments thereof are respectively defined in the claims dependent thereon. In particular, claims 9 and 10 define a computer program working according to the inventive method.

30

The central feature of the present invention is to write additionally generated data to at least one specific portion of the record carrier so that a general purpose reading device which can access record carriers of different formats which accesses said record carrier judges said record carrier to be
35 unaccessable and that a record carrier according to the present invention comprises at least one specific portion with such additionally generated data.

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1 Therewith, according to the present invention such additionally generated
data which confuses a reading device is inserted in such areas which are
not accessed by a reading device designed for that type of record carriers,
e.g. a normal audio CD player for audio CDs, but which are always accessed
5 by a general purpose reading device, e.g. a CDROM reading device.

The additionally generated data is generated and stored additionally to the
data intended to be recorded and the data needed for accessing the data
intended to be recorded.

10 The term 'write ... to at least one specific portion of the record carrier' is not re-
stricting the scope to a direct writing to the record carrier, e.g. to a CDR (CD rec-
ordable), but also includes the writing to a master from which record carriers are
replicated.

15 Record carriers of different formats are not only different types of record carriers,
e.g. CDs and DVDs, but also one type of record carriers which can record multiple
sessions of the same or different types.

20 A session in this sense means a data stream recorded without interruption with a
lead-in portion at the beginning, a lead-out portion at the end, and eventually a
middle area in-between different parts of the data stream.

25 According to the present invention said data generation comprises the step
of generating at least one special pattern which is decoded so that no clock
regeneration of the stored data can be performed by said reading device
when accessing the at least one specific portion of the record carrier which
stores said special pattern.

30 In case a reading device tries to access the specific portion comprising the
so generated data it is not possible for said reading device to regenerate
the clock of the stored data. In this case the general purpose reading de-
vice will generate an error message indicating that the inserted record car-
rier is not accessible.

35 Alternatively or additionally to achieve such a result said data generation
comprises the step of copying a synchronization pattern at least once into

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1 said at least one specific portion of the record carrier at a respective position normally not having a synchronization pattern. In this case the reading device trying to access the specific portion does not find the correct synchronization, since it gets confused by the higher number of synchronization patterns, and the result is the same as in the case described before. Such a copying also includes the simulation of a synchronization pattern by modifying standard data bytes to look like a synchronization pattern.

10 Therewith, according to the present invention a method is defined how to modify the physical data stream on an optical storage disc to influence the decoding process in a way, that it is impossible to find the exact synchronization and timing. This may lead either to stopping of the decoding process or at least to a wrong decoding of data symbols.

15 However, according to the present invention this influencing of the decoding process is only performed in case a general purpose reading device which can access record carriers of different formats, i.e. record carriers which can record multiple sessions, tries to access the record carrier provided with the copy protection according to the present invention. Reading devices which are specially designed for a record carrier of a predetermined format, e.g. audio data recorded in one session, can still access a record carrier provided with the copy protection according to the present invention if that patterns are e.g. included in the lead-in portion of the second session. General purpose reading devices which support multiple formats need to at least analyze the lead-in portion of the second session and in this way the decoding process gets confused. Such reading devices which are specially designed for a record carrier of a predetermined format are not limited to new specially adapted reading devices, but all existing reading devices of this type already fulfill the necessary requirements.

30 This strategy according to the present invention is also applicable to the pregap portion of an audio CD, i.e. the gap portion before the audio content starts.

Alternatively or additionally to the inserted patterns for misleading the clock regeneration or the synchronization, it is also possible to generate a modified pointer to a further session on a multi session record carrier. Such a pointer to a further session on a multi session record carrier, in the following also referred to as session pointer, is arranged in the lead-in portion of a session and points to the beginning of

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1 the data area of the following session. An appropriate modification of this pointer
leads to the wanted confusion of the general purpose reading device. According to
the present invention, preferably a recursive pointer might be defined, further pre-
5 ferrably in the third session, which does not point to the beginning of the data area
of the following session, but to the beginning of the data area of the same session.
In case a general purpose reading device tries to access the so modified record car-
rier, it gets confused and judges this record carrier as unaccessible.

Furthermore, it is an object underlying the present invention to provide a general
10 purpose reading device which can access record carriers provided with the copy
protection according to the present invention.

This object is solved by a record carrier accessing device according to independent
claim 19 which is switchable or preprogramable to not read at least one pre-
15 determined portion of a predetermined type of record carriers to be ac-
cessed, namely to not read the at least one specific portion of the record
carrier which stores the above described additionally generated data.

The accompanying drawings, which are incorporated in and constitute a part of this
20 specification, illustrate embodiments of the invention and, together with a general
description of the invention given above, and the detailed description of the embodi-
ment given below, serve to explain the principles of the invention, wherein:

Figure 1 illustrates the CD frame format;
25 **Figure 2** shows the decoding process for record carriers which store data in asyn-
chronous streams; and
Figure 3 elucidates the principle of a recursive session pointer according to the
present invention.

30 The following description shows as an example how to modify the physical data
stream of an audio CD to prevent correct decoding within a multi session capable
reading device, i.e. a general purpose reading device. The format of the physical
data stream is specified in the 'Red Book' specification and IEC 908.

35 The physical data stream on a CD is optimized in multiple ways to reduce errors
and guarantee a simple decoding mechanism. Therefore every 3 to 11 bits must be
a transition of the signal. Within the data symbols this is guaranteed by the EFM

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1 (Eight to Fourteen Modulation). The audio data is split into 8 bit symbols which are converted to a 14 bit symbol with the EFM table. This table consist of 256 entries of 14 bit values which are combinations of bits which contain more than 2 but less than 10 zeros continuously. Every '1' in the 14 bit symbol represents a transition of
 5 the signal. To also guarantee this restriction when symbols are concatenated there are additional 3 bits of merging, which must be chosen accordingly. The resulting signal between two transitions are called pits and lands. The length of each is bounded between 3 and 11 times the base length.

10 The final frame of audio data contains the following data:

	1 synchronization symbol	24 bits
	1 subcode byte	14 bits (EFM encoded)
	24 data bytes	336 bits (EFM encoded)
15	8 parity bytes	112 bits (EFM encoded)
	34*3 merging bits	102 bits
<hr/>		
	TOTAL	588 bits

20 The bits are composed is the way as shown in figure 1. The order of one CD frame is as follows: the synchronization pattern of 24 bits is followed by 3 auxliary bits for merging and low frequency suppression; thereafter 14 bits subcode data are followed by 3 auxliary bits for merging and low frequency suppression; thereafter 12 blocks of 14 bits information data are respectively followed by 3 auxliary bits for
 25 merging and low frequency suppression; thereafter 4 blocks of 14 bits parity data are respectively followed by 3 auxliary bits for merging and low frequency suppression; thereafter 12 blocks of 14 bits information data are respectively followed by 3 auxliary bits for merging and low frequency suppression; and finally 4 blocks of 14 bits parity data are respectively followed by 3 auxliary bits for merging and low frequency
 30 suppression.

Figure 2 illustrates the decoding process, which can be influenced according to the present invention by confusing either the clock regeneration or the synchronization detection and timing.

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The input signal to the decoder read out from the disc undergoes a bit detection 1 followed by a demodulation 2 with following error correction 3 and channel demul-

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1 multiplexing 4. The output signal from the bit detector 1 is input to a clock regenera-
tion circuit 5 and also to a synchronization detection and timing circuit 6 which ad-
ditionally receives the output signal of the clock regeneration circuit 5. The syn-
chronization detection and timing circuit 6 supplies its output signal to the channel
5 demultiplexer 4 which outputs a first signal to a D/A converter and lowpass filter 7
to generate the first channel ch1 of audio output and a second signal to a D/A con-
verter and lowpass filter 8 to generate the second channel ch2 of audio output. The
output signal from the demodulator 2 is additionally input to a control and display
decoding unit 9 which supplies a control functions means 10 and a display 11 with
10 input signals.

Confusing clock regeneration:

Normally data symbols vary in the data signal, so each pit length should be avail-
able within some frames. Each CD drive uses special patterns for retrieving clock-
15 ing information out of the signal, if this pattern is not available the CD drive is not
able to continue decoding. Usage of certain patterns for user data allows to remove
patterns which a CD drive needs for clock regeneration and so prevents to decode
data correctly.

20 Confusing synchronization and timing:

The synchronization symbol is the bit sequence '100000000001000000000010'
which include 3 transitions of the signal. Normally the merging algorithm has to be
selected in a way to avoid that this signal occurs within the data symbols. Search-
ing the data stream for this signal makes it possible for the decoder to find the start
25 of a CD frame. Usage of certain patterns for user data and modifying the merging
algorithm allows to have the synchronization symbol multiple times within a frame
which so prevents that the CD drive finds the correct synchronization symbol (start
of frame) and furthermore prevents to decode data correctly.

30 Figure 3 elucidates the principle of session pointers, i.e. pointers arranged in the
lead-in portion of a session pointing to the beginning of the data area of the respec-
tively directly following session which is modified according to a preferred embod-
iment of the present invention in that one of these session pointers, here the session
pointer normally pointing from the lead-in portion of the third session to the begin-
35 ning of the data area of the fourth session, is a recursive pointer and points to the
beginning of the data area of the session in which it itself is arranged, here to the
beginning of the data area of the third session. This principle is elucidated for an

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1 audio CD modified according to the present invention which comprises at least three sessions, each of which has a lead-in portion, a data area, and a lead-out portion.

5 According to the present invention, both methods of confusing decoding can be used for copy prevention independently or together because the decoding gets out of order. Further, also the arrangement of a recursive session pointer might be used alone or together with the confusing decoding according to the present invention. An intelligent placement of regions where the signal is modified for copy prevention
10 allows to keep ability of playback of user data with a reading device specially adapted to the recorded user data, e.g. to audio data recorded on audio CDs, but prevents of making a copy.

Similar modifications can be done for DVD, which uses similar layout of the signal
15 and for the decoding process.

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Claims

1. Method to produce a record carrier which stores data as an asynchronous signal, **characterized by the following step:**
 - 5 - writing additionally generated data to at least one specific portion of the record carrier so that a general purpose reading device which can access record carriers of different formats which accesses said record carrier judges said record carrier to be unaccessible.
- 10 2. Method according to claim 1, **characterized in that** said data generation comprises the step of generating at least one special pattern which is decoded so that no clock regeneration of the stored data can be performed by said reading device when accessing the at least one specific portion of the record carrier which stores said special pattern.
- 15 3. Method according to claim 1 or 2, **characterized in that** said data generation comprises the step of copying a synchronization pattern at least once into said at least one specific portion of the record carrier at a respective position normally not having a synchronization pattern.
- 20 4. Method according according to anyone of the preceding claims, **characterized in that** said generated data is arranged to be written to a lead-in portion and/or a middle area and/or a lead-out portion of a session recorded on the record carrier.
- 25 5. Method according according to anyone of the preceding claims, **characterized in that** said additionally generated data comprises a modified session pointer.
- 30 6. Method according to claim 5, **characterized in that** said modified session pointer is a recursive session pointer.
7. Method according to claim 5 or 6, **characterized in that** said modified session pointer is arranged in the third session
- 35 8. Method according according to anyone of the preceding claims, **characterized in that** said record carrier is a CD or DVD.

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- 1 9. Computer program having program code means to perform all steps
according to anyone of claims 1 to 8, if the program is run on a computer.
- 5 10. Computer program having program code means according to claim 9
being stored on a computer accessible storage means.
- 10 11. Record carrier which stores data as an asynchronous signal, **characterized by** additionally generated data within at least one specific portion of the record carrier so that a general purpose reading device which
can access record carriers of different formats which accesses said record
carrier judges said record carrier to be unaccessable.
- 15 12. Record carrier according to claim 11, **characterized in that** said
additionally generated data comprises at least one special pattern which
is decoded so that no clock regeneration of the stored data can be performed by said reading device when accessing the at least one specific
portion of the record carrier which stores said special pattern.
- 20 13. Record carrier according to claim 11 or 12, **characterized in that**
said additionally generated data comprises at least one synchronization
pattern at a respective position normally not having a synchronization
pattern.
- 25 14. Record carrier according according to anyone of claims 11 to 13,
characterized in that said generated data is arranged within a lead-in
portion and/or a middle area and/or a lead-out portion of a session recorded on the record carrier.
- 30 15. Record carrier according according to anyone of claims 11 to 14,
characterized in that said additionally generated data comprises a modified session pointer.
- 35 16. Record carrier according to claim 15, **characterized in that** said
modified session pointer is a recursive session pointer.
17. Record carrier according to claim 15 or 16, **characterized in that**
said modified session pointer is arranged in the third session.

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1 18. Record carrier according according to anyone of claims 11 to 17,
characterized in that said record carrier is a CD or DVD.

5 19. Record carrier accessing device, **characterized in that** it is
switchable or preprogramable to not read at least one predetermined por-
tion of a predetermined type of record carriers to be accessed.

10 20. Record carrier writing device for writing record carrieres which store
data as an asynchronous signal, **characterized by** being able to write ad-
ditionally generated data to at least one specific portion of the record car-
rier so that a general purpose reading device which can access record car-
riers of different formats which accesses said record carrier judges said
record carrier to be unaccessible.

15 21. Record carrier writing device according to claim 20, **characterized**
by being able to write patterns to said at least one specific portion of the
record carrier so that for a reading device no clock regeneration of the
stored data can be performed when accessing said at least one specific
portion of said record carrier.

20 22. Record carrier writing device according to claim 20 or 21, **charac-**
terized by being able to write synchronization patterns to said at least
one specific portion of the record carrier outside areas which are defined
for synchronization patterns.

25 23. Record carrier writing device according to anyone of claims 20 to
22, **characterized by** being able to write a modified session pointer.

30 24. Record carrier writing device according to of claim 23, **characteriz-**
ed by being able to write a recursive session pointer.

35 25. Record carrier writing device according to of claim 23 or 24, **charac-**
terized by being able to write said modified session pointer in the third
session.

Figure 1: CD frame format

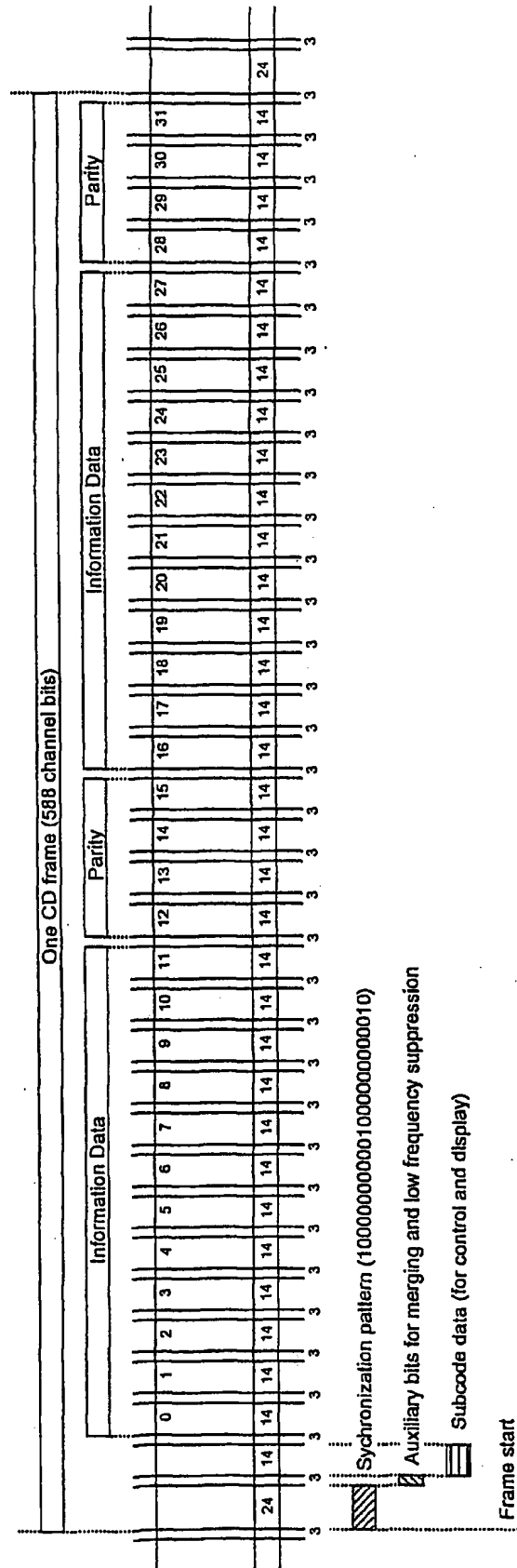
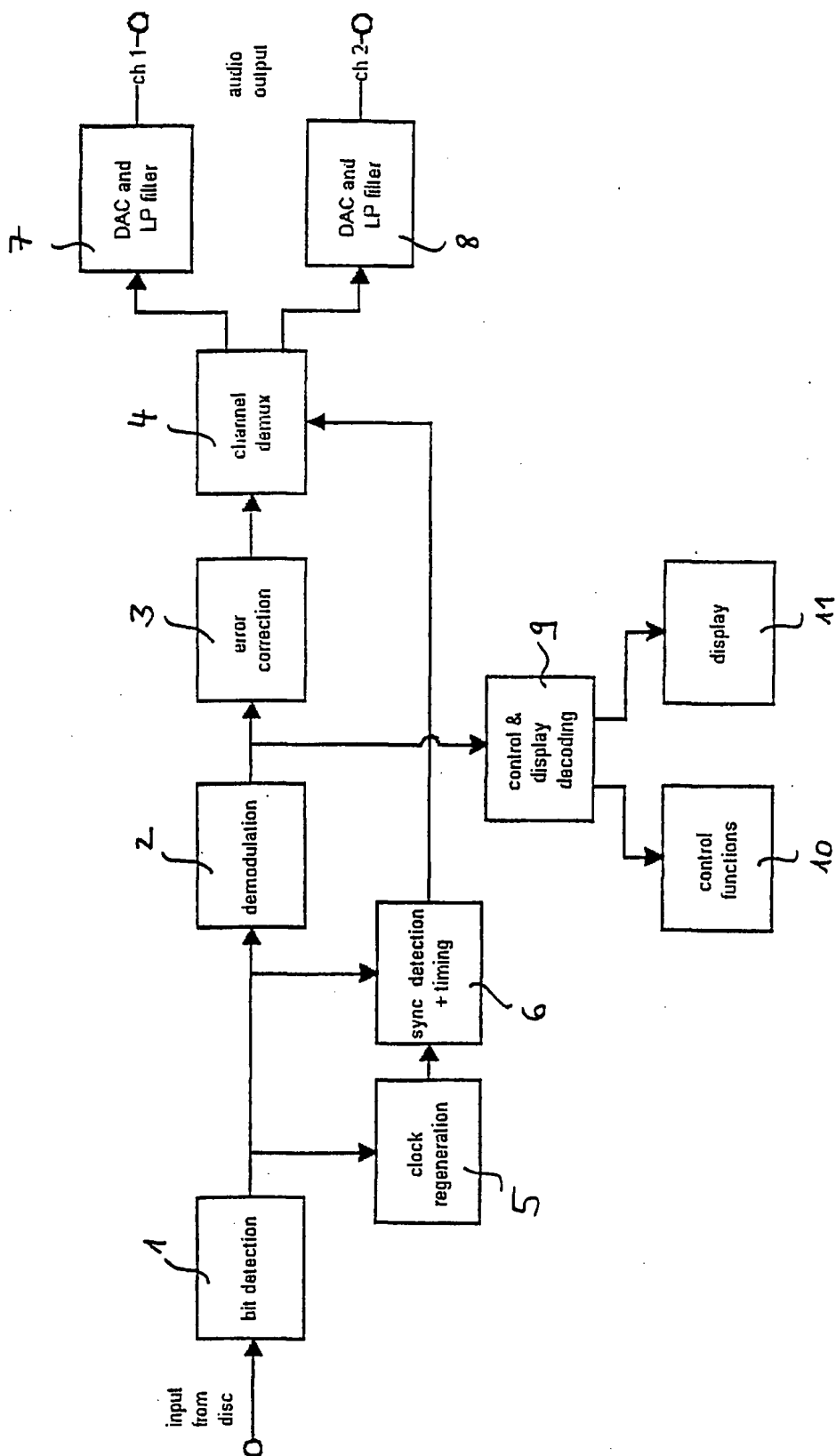


Figure 2: Decoding process



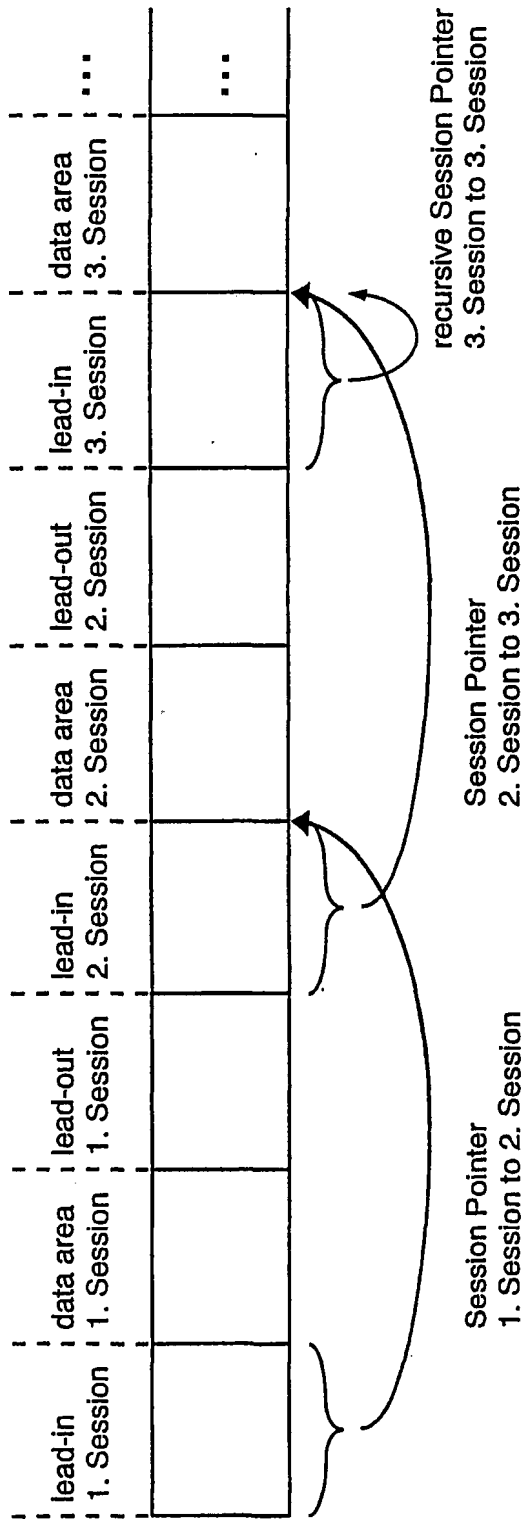


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/02633

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G11B20/00 G11B20/14 G06F1/00 G11B20/12		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 G11B G06F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ, INSPEC		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 005 839 A (OWA HIDEO ET AL) 21 December 1999 (1999-12-21) cited in the application column 1, line 43 - line 46 column 3, line 55 - column 6, line 53 column 9, line 8 - column 10, line 9	1-4, 8, 11-14, 18-22
A	WO 98 08180 A (T T R TECHNOLOGIES LTD) 26 February 1998 (1998-02-26) the whole document	1-4, 8, 11-14, 18-22
A	WO 00 67095 A (TRYMEDIA SYSTEMS) 9 November 2000 (2000-11-09)	
<input type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 29 June 2001		Date of mailing of the international search report 10/07/2001
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Ogor, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 01/02633

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